

Kings lomatia

Lomatia tasmanica



Flora Recovery Plan 2006 - 2010



Australian Government



Tasmania

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Abbreviations:

DEH	Commonwealth Department of Environment and Heritage
DPIW	Department of Primary Industries and Water, Tasmania (formerly DPIWE - Department of Primary Industries, Water and Environment)
DTAE	Department of Tourism, Arts and Environment
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
NRM Region	Natural Resource Management Region
S	Southern NRM region
PWS	Parks and Wildlife Service, DTAE
RTBG	Royal Tasmanian Botanical Gardens, DTAE
TSP Act	<i>Threatened Species Protection Act 1995</i>
TSS	Threatened Species Section, DPIW (formerly TSU – Threatened Section Unit)
TWWHA	Tasmanian Wilderness World Heritage Area

Taxonomy follows Buchanan (2005) except where otherwise noted.

The listing status of the threatened species referred to in this recovery plan was correct at the time of publication.

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SUMMARY

Current Species Status

Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* Critically Endangered
 Tasmanian *Threatened Species Protection Act 1995* endangered

Lomatia tasmanica W. M. Curtis (1967), commonly known as King's lomatia, was first collected by Denny King in May, 1934. The only known population occurs in southwest Tasmania. The population covers an area of 1.2 square kilometres in a single patch of mixed forest. There are estimated to be between 400 to 500 stems, with all individuals thought to be genetically identical (Lynch *et al.* 1998). The entire population is contained within the Southwest National Park that is part of the Tasmanian Wilderness World Heritage Area.

A continuing decline is inferred because of small population size and risk from fire and *Phytophthora cinnamomi*.

Habitat Requirements, Threats and Limiting Factors

Lomatia tasmanica is found within a mixed forest in southwest Tasmania in a cool moist environment adjacent to two minor creeks. The forest has emergent *Eucalyptus nitida* and a rainforest element dominated by *Nothofagus cunninghamii*. Genetic studies have revealed that this species is a single giant clone that reproduces by suckering and coppice alone and dispersal mechanisms are therefore limited. No fruit or seeds have ever been recorded. It is now known only from one population. This species has proven difficult to cultivate, limiting the potential for *ex situ* population establishment.

The range of the species has declined, probably due to a decreased interval between fires. Despite reservation in a National Park and World Heritage Area the species is still under threat from extinction due to its limited distribution and lack of genetic diversity. The main external threats to the species are wildfire and infection by the root rot pathogen, *Phytophthora cinnamomi*. The population is likely to recover after a wildfire, however an increase in fire frequency would most probably eliminate the species entirely. *Phytophthora cinnamomi* occurs both on the plains and on the western ridge adjacent to the *Lomatia tasmanica* population and as close as 20 metres to the first plant. The disease risk is increased by visitation to the population for collection and research and management.

Overall Recovery Objective

The overall objective of this Recovery Plan is to prevent the single population of *Lomatia tasmanica* from declining further and to ensure that this unique species does not become extinct. This will require maintaining the existing population and working towards establishing and increasing the number of individuals in *ex situ* populations.

Specific Objectives

1. To increase the level of protection surrounding the existing population.
2. To actively ensure numbers of individuals in the known population do not decline by inappropriate disturbance regimes or infection by *Phytophthora cinnamomi*.
3. Develop mechanisms to increase the number of *ex situ* individuals.
4. Develop a more comprehensive understanding of the species lifecycle and habitat requirements.

Performance Criteria

1. Over the duration of the plan, no decline in the area occupied by the known populations due to anthropogenic spread of *Phytophthora cinnamomi*.
2. Over the duration of the plan, no decline in the area occupied due to a change in fire regimes.
3. Over the duration of the plan, positive outcomes in propagation methods and ongoing survival of *ex situ* plants.
4. Over the duration of the plan, determination of whether additional disturbance is required in the remaining population.
5. Identification of potential habitat for *ex situ* establishment of new populations.
6. Monitoring of the population at least once over the duration of this plan, in particular to determine whether there is a decline in numbers.
7. Establishment of a Recovery Team to implement this plan or parts thereof.
8. Update listing statement, spatial and population data as required.
9. Maintenance of the TSS database (ie: new populations, population decline and threshold conditions) and annual assessment to determine whether management intervention is required
10. Update the Recovery Plan by the end of 2010.

Actions Needed

1. Declare a quarantine zone in the catchment area of the existing population.
2. Conduct mycorrhizal isolation and study trials to determine *Lomatia tasmanica's* requirements for *ex situ* survival.
3. Test and use successful propagation techniques to establish *ex situ* populations.
4. Conduct a desktop assessment using Geographical Information Systems (GIS) software to assess all potential habitat and suitable areas for establishing *ex situ* populations.
5. Monitor disturbance requirements relative to recruitment needs and monitor infection by *Phytophthora cinnamomi*.
6. Determine appropriate disturbance requirements to promote or maintain health and recruitment in the existing population.
7. Advise and help Park Managers to manage habitat in order to maintain or increase population size through protection from wildfire and *Phytophthora cinnamomi*, with the aim of maintaining or increasing recruitment.
8. Establish an emergency response mechanism to serious impact by *Phytophthora cinnamomi* if and when detected.
9. Develop mechanisms involving the community to manage and better protect the population and plantings in the long term.

Estimated Cost of Recovery

Actions	Cost estimate	Timeframe	NRM region
1. Declaration of a quarantine zone	\$4,000	Year 1-2	S
2. Habitat quantification	\$15,000	Year 1-3	S
3. Propagation	\$20,000	Year 1-4	S
4. Identify potential habitat	\$5,000	Year 1-3	S
5. Monitoring	\$10,000	Year 1-5	S
6. Determine appropriate disturbance requirements	\$10,000	Year 1-4	S
7. Habitat management	\$5,000	Year 1-5	S
8. Emergency response mechanisms	\$2,000	Year 1-3	S
9. Long-term management	\$14,000	Year 1-5	State
Total	\$85,000		

BACKGROUND INFORMATION

Description

Lomatia tasmanica is a spindly shrub between 2 and 8 m in height. The plants often branch at the top of a thin trunk, although the trunk may be horizontal with a few erect branches. The young stems and buds are pubescent, with simple rusty brown hairs. The leaves are pinnate, alternately arranged and mostly crowded at the ends of the branches. They are 10 to 18 cm long and 2.5 to 4 cm wide. Typically each leaf has 7 to 11 pairs of leaflets that are stalkless and fuse with the stem. The leaflets are oblong or lanceolate (lance-shaped) in outline and irregularly toothed or lobed. The leaf surface is leathery, glossy and dark green with an obvious network of veins. The upper surface is not hairy except on the veins nearest the base. The lower surface of the leaf has scattered hairs. The rachis (axis bearing leaflets) is pubescent except where covered by decurrent bases of the leaflets.

Inflorescences occur at the ends of branches on a simple elongated stem with stalked flowers. The inflorescence is typically shorter or scarcely longer than the uppermost leaves. Flowers are in pairs, on flower stalks that are 6 to 7 mm long. The floral whorl has segments that are thick, fleshy, hairless and dull crimson in colour. The flowers are generally between 8 to 10 mm in length. The style (elongated tube between ovary and stigma) is scarcely longer than the perianth (floral whorl) and the end is trumpet-like forming a thick, flat, crimson disk. The stigma (receptive pollen surface) arises from the centre of the disk, and is small and conical. Fruit has not been recorded.

Lomatia tasmanica has no similar or confusing species.

Taxonomic Status

Lomatia comes from the Greek *loma*, a fringe, referring to the wing that surrounds the seed. *Lomatia*, from the family Proteaceae, is a genus that contains 14 known species. Most of these occur in south-eastern Australia, although three are known to occur in South America. There are three species of *Lomatia* endemic to Tasmania, *Lomatia tasmanica*, *Lomatia tinctoria* and *Lomatia polymorpha*. *Lomatia tasmanica* was described by W.M. Curtis in 1967.

Distribution and Habitat

Lomatia tasmanica only occurs in one population, in a relatively small area in the southwest of Tasmania. A population was also recorded nearby in 1934, however it has not been located again and is thought to now be extinct. The habitat is not rare within the region and therefore the range and type of habitats suitable for *L. tasmanica* are not the cause of its restricted distribution (Lynch & Balmer 2004).

The population extends over 1.2 kilometres between 80-280 m in altitude. At this site *Lomatia tasmanica* is found in a mixed forest with emergent *Eucalyptus nitida*. The rainforest element of this forest is dominated by *Nothofagus cunninghamii*, *Phyllocladus aspleniifolius* and *Eucryphia lucida*. The *Lomatia tasmanica* population is located along creek margins and appears to be more common on open ground that has been disturbed by tree-fall.

Population Estimate

Lomatia tasmanica is currently known from only one population in southwest Tasmania. The total number of plants at this site is estimated at between 500-600 plants. The clonal nature and longevity of the species through vegetative reproduction is consistent with the hypothesis that now extinct population (found in 1934) was a fragment of a previously more widespread population of the same clone. Suitable habitat in the area has been searched for further occurrences and no new populations are likely to form naturally.

Life History and Ecology

Lomatia tasmanica is a unique, vulnerable species as it only occurs in one population and does not sexually reproduce. Genetic studies have deduced that the population is a large sterile clone. The species regenerates by root suckering and coppice alone, due to its inability to produce seeds. The species is triploid (three sets of chromosomes) which is rare in nature. *Lomatia tasmanica* is the only known triploid member of the Proteaceae. There are two other endemic species of *Lomatia* in Tasmania, both have stable chromosome numbers. One of these, *Lomatia tinctoria*, has a normal level of genetic diversity within populations, reproduces sexually as well as vegetatively. The lack of genetic diversity within the *L. tasmanica* population suggests the species has arisen from a single event from a now extinct ancestor no longer occurring in Tasmania (Lynch *et al* 1998). The family Proteaceae was far more diverse during the Tertiary in Tasmania (Carpenter & Jordan 1997) and early Oligocene deposits at Leven River and Cethana provide microfossil evidence for the genera *Telopea* and *Lomatia* (Johnson and Briggs 1975).

The species flowers around January and February, but not necessarily annually. The duration of flowering is unknown with records of old flowers being visible in both August and March. No records of fruit or seed exist. This apparent sterility is in keeping with the genetic findings that the species is a triploid and the morphological observations of a lack of natural variation.

The current distribution of *L. tasmanica* along creek margins and being more common on open ground that has been disturbed by tree-fall suggests that recruitment is facilitated by gaps. The species is slow growing, with tree-ring counts ageing an individual stem of 2 cm in diameter at about 60 years and another stem of 6.3 cm at approximately 240 years (I. Bird 1985), despite the rings being poorly formed making accurate counting difficult. The stems recorded at the site vary in size classes up to about 7 cm in diameter (Brown & Gray 1985). The size of the area encompassed by the clone suggests that it is very old (Lynch *et al.* 1998). Palaeobotanical studies by Jordan *et al.* (1991) found a leaf fossil at Melaleuca Inlet, which they identified as being identical to *L. tasmanica* and dated the specimen to approximately 43,600 years of age. Lynch *et al.* (1998) suggest that this finding may indicate the minimum age for the giant clone.

The current population of *L. tasmanica* appears to be the last refuge of the species. Its disjunct distribution is likely to be due to fire fragmenting a previously larger continuous population (Lynch *et al* 1998) which would have covered an area between creeks now dominated by fire induced buttongrass sedgeland. It is thought that the species may survive wildfires, provided that the interval between fires allows the population to recover between fire events.

Threats, Limiting Factors and Management Issues

Despite secure reservation in a National Park and World Heritage Area, *Lomatia tasmanica* is critically endangered under the EPBC Act and endangered under the TSP Act. This risk is mainly due to the extremely limited distribution of one population covering 1.2 kilometres and lack of genetic diversity. The population is composed of a single sterile clone that reproduces only by suckering and coppice. The limited mechanisms of reproduction and dispersal are a bottleneck for the survival of the species. There are also external threats to the survival of *Lomatia tasmanica* and the population is in decline. The external threats are potentially increased due to risks associated with the occurrence of the species in an area that is accessible to the public. Given this species' iconic status the strong desire for public visitation to the population has to be considered in management.

The main external threats to the species are wildfire and infection by the root rot pathogen, *Phytophthora cinnamomi*. In 2001, Tim Rudman (DPIWE) conducted a *P. cinnamomi* susceptibility trial on two small plants of *Lomatia tasmanica* and found the species to be susceptible to the pathogen. Whilst this is not a comprehensive study, a precautionary approach is recommended. Staff at the Royal Botanical Gardens, Kew believe potted plants within their *L. tasmanica* collection may have also succumbed to *Phytophthora*-induced mortality.

Tim Rudman has also verified that *P. cinnamomi* occurs on the plains and on the western ridge adjacent to the *Lomatia tasmanica* population and as close as 20 metres to the first plant. The risk of the introduction and spread of *P. cinnamomi* is increased by visitation for collection, research and management.

The current population structure indicates that the majority of the population was burnt in the 1930s, and only a few plants survived (Lynch & Balmer 2004). It appears that the population regenerated from these few plants and/or below ground (undamaged) roots. Therefore we know *L. tasmanica* can recover after a wildfire, however, an increase in the frequency of fires could eliminate the species entirely. The previously disjunct distribution, of the current population and a now extinct second population separated by fire-induced buttongrass moorland reinforces this observation. It is possible the extinct population became extinct due to an increase in fire frequency (Brown & Gray 1985). Public access to the area increases the chance of deliberate or accidental fire.

Most importantly the risk of *Phytophthora cinnamomi* infection is much greater once a fire has occurred. Forest canopies provide protection against infection as they maintain soil temperatures below 15^o C, which is the threshold for infection by *P. cinnamomi* (Podger & Brown 1989). So even though the population may survive a fire, its susceptibility to *P. cinnamomi* increases drastically.

The establishment of *ex situ* populations can decrease the extinction risk to the species. As well as decreasing the stochastic risk, availability of easily accessible plants may reduce public visitation and associated risks. However, attempts to establish *ex situ* populations of *Lomatia tasmanica* have met with limited success. Plants in cultivation are slow growing, tend to become covered in a black sooty mould and plants are difficult to keep alive. Propagation can only be achieved through vegetative means. This has been largely unsuccessful with two main problems being identified:

- A high percentage of contamination whatever disinfection treatments are applied
- A rapid blackening of most of the cuttings due to phenolic production, which is common in most members of the Proteaceae.

Reservation Status

Lomatia tasmanica is securely reserved in the Southwest National Park, which is part of the Tasmanian Wilderness World Heritage Area.

Reasons for Listing and Habitat Critical

Lomatia tasmanica meets the criteria for the Critically Endangered (CR) category under the **Commonwealth Environment Protection and Biodiversity Conservation Act 1999**

Lomatia tasmanica qualifies for listing as endangered (e) at the State level using the guidelines for the listing of species on the Tasmanian **Threatened Species Protection Act 1995** under:

Rule B. The extent of occurrence is estimated to be less than 5000 km², or area of occupancy estimated to be less than 500 km² and 1) it is known from less than 5 locations and 2) there is a continuing decline observed, inferred or projected in the (a) extent of occurrence, (b) area of occupancy and (c) area, extent and/or quality of habitat.

A continuing decline is inferred from *Phytophthora cinnamomi* infection and wildfire.

Rule C. The total population size is estimated to number fewer than 2 500 mature individuals and 2) a continuing decline is observed, inferred or projected in numbers of mature individuals and population structure as (b) all individuals are in a single population.

Lomatia tasmanica meets the following criteria of IUCN (World Conservation Union) Red List guidelines (2001) because:

Rule A. Reduction of population size based on 4) an observed, estimated, inferred, projected or suspected population size reduction of ≥80% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not

have ceased or may not be understood or may not be reversible, based on c) a decline in area of occupancy, extent of occurrence and or quality of habitat and e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

One of two populations of *Lomatia tasmanica* has disappeared since 1934 and the reason is unknown. In addition the extent of the surviving population is threatened by the pathogen *Phytophthora cinnamomi*.

Rule B. 1) Extent of occurrence is estimated to be less than 100km² and a) known to exist at only a single location and b) continuing decline observed, inferred or projected in (i) extent of occurrence, (ii) area of occupancy and (iii) area, extent and/ or quality of habitat. 2) Area of occupancy estimated to be less than 10 km², and 2) the area occupied is less than 10 km² and as above for (a) and (b).

Lomatia tasmanica exists in only one known location. A decline is projected for both the area of occupancy and occurrence in that single remaining population. The quality of the existing habitat is also under threat from both *Phytophthora cinnamomi* and wildfire. The area occupied by *Lomatia tasmanica* is estimated to be 1.2 km².

In order to down-list the species, the area of occupancy would need to be increased substantially and at least two new *ex situ* populations would need to be established. Before new populations can be established a better understanding of the ecology of the plant for successful cultivation would need to be developed. A substantial increase in the area of occupancy is not considered feasible due to the difficulty of cultivation and the remote location of the existing stand.

Habitat considered critical to the survival of the species comprises

- The only known living population of *Lomatia tasmanica* occurs in Southwest Tasmania. This site is critical for ensuring the species survival.
- The extinct population site. Even though now extinct from the site, *L. tasmanica* previously occurred at the site and therefore may be a suitable site for the reintroduction of the species. Other potential sites for *ex situ* populations have not yet been determined.

Existing Conservation Measures

The first Recovery Plan for *Lomatia tasmanica* was prepared in 1991 (Lynch 1991). Since then genetic studies have identified that the species is sterile and does not produce seeds. Additionally researchers have since described the species as the oldest living of vascular plant in the world (Lynch *et al* 1998), and as a result the species has received considerable attention. Additionally *Phytophthora cinnamomi* isolation tests and propagation trials have recently identified the species' potential susceptibility to infection. The actions identified in the last Recovery Plan to "increase knowledge and survival of *Lomatia tasmanica*" have not been undertaken. Instead, small grants and assistance through other organisations and agencies have improved the understanding and protection of this species. The few plants held in cultivation are a valuable resource, however, success in growing and maintaining the collection has been limited. A list of the *ex situ* plant collections is given in Appendix 1.

RECOVERY PLAN

Recovery Objectives, Performance Criteria and Actions Needed

The **overall objective** of this Recovery Plan is to prevent *Lomatia tasmanica* from declining further and to ensure that this unique species does not become extinct. This will require maintaining the existing population and working towards increasing the number of individuals in *ex situ* populations.

Specific objectives are:

1. To increase the level of protection surrounding the existing population.
2. To actively ensure numbers of individuals in the known population do not decline by inappropriate disturbance regimes or infection by *Phytophthora cinnamomi*.
3. Develop mechanisms to increase the number of *ex situ* individuals.
4. Develop a more comprehensive understanding of the species lifecycle and habitat requirements.

The **criteria** for achieving the objectives constitute a quantifiable decrease in the risk of extinction over 5 years of Recovery Plan implementation. They are:

1. Over the duration of the plan, no decline in the area occupied by the known populations due to anthropogenic spread of *Phytophthora cinnamomi*. **Specific objective 1**
2. Over the duration of the plan, no decline in the area occupied due to a change in fire regimes. **Specific objective 1**
3. Over the duration of the plan, positive outcomes in propagation methods and ongoing survival of *ex situ* plants. **Specific objective 3**
4. Over the duration of the plan, determination of whether additional disturbance is required in the remaining population. **Specific objective 2**
5. Identification of potential habitat for *ex situ* establishment of new populations. **Specific objective 3**
6. Monitoring of the population at least once over the duration of this plan, in particular to determine whether there is a decline in numbers. **Specific objective 2**
7. Establishment of a Recovery Team to implement this plan or parts thereof. **Specific objective 2, 3 and 4**
8. Update listing statement, spatial and population data as required. **Specific objective 4**
9. Maintenance of the TSS database (ie: new populations, population decline and threshold conditions) and annual assessment to determine whether management intervention is required. **Specific objective 1 and 4**
10. Update the Recovery Plan by the end of 2010. **Specific objective 4**

The **actions** required for achieving the objectives are:

1. Declare a quarantine zone in the catchment area of the existing population. **Specific objective 1 and performance criteria 1, 6, 7, 8 and 10**
2. Conduct mycorrhizal isolation and study trials to determine *Lomatia tasmanica*'s requirements for *ex situ* survival. **Specific objective 3 and 4 and performance criteria 3, 5, 7, 8, and 10**
3. Test and use successful propagation techniques to establish *ex situ* populations. **Specific objective 3 and performance criteria 3, 5, 7, 8 and 10**
4. Conduct a desktop assessment using Geographical Information Systems (GIS) software to assess all potential habitat and suitable areas for establishing *ex situ* populations. **Specific objective 3 and performance criteria 3, 5, 7, 8 and 10**
5. Monitor disturbance requirements relative to recruitment needs and monitor infection by *Phytophthora cinnamomi*. **Specific objectives 2, 3 and 4, and performance criteria 1, 4, 6, 7, 8, 9 and 10**
6. Determine appropriate disturbance requirements to promote or maintain health and recruitment in the existing population. **Specific objective 2 and performance criteria 1, 2, 4, 6, 7, 8 and 10**
7. Advise and help Park Managers to manage habitat in order to maintain or increase population size through protection from wildfire and *Phytophthora cinnamomi*, with the aim of maintaining or increasing recruitment. **Specific objective 2 and 3 and performance criteria 1, 2, 4, 6, 7, 8, 9 and 10**
8. Establish an emergency response mechanism to serious impact by *Phytophthora cinnamomi* if and when detected. **Specific objective 2 and performance criteria 1, 6, 7, 8, 9 and 10**
9. Develop mechanisms involving the community to manage and better protect the population and plantings in the long term. **Specific objective 1, 2 3 and 4 and performance criteria 1, 2, 3, 4, 5, 6 and 7**

Strategy for Recovery and Progress Evaluation

The *Lomatia tasmanica* Recovery Plan will run for five years and is based on strategies to increase the existing knowledge of the species' habitat requirements, increase the number of *ex situ* populations, maintain or increase numbers of individuals and habitat quality and manage the species in the long term. This will be achieved by:

- Improving protection against *Phytophthora cinnamomi* infection and repeat wildfire
- Identifying disturbance requirements
- Survey and monitoring of the existing population
- Establish representative *ex situ* populations.

This plan has been prepared in consultation with various representatives of the Threatened Species Section and Vegetation Section of the Biodiversity Conservation Branch of the Department of Primary Industries, Water and Environment, representatives of the Tasmanian Herbarium, the Royal Tasmanian Botanical Gardens and a network of professional botanists and active volunteers concerned with threatened flora issues in Tasmania. A Recovery Team will be established once funding to implement this plan or parts of the plan is secured.

Each year following establishment, the Recovery Team will monitor and evaluate progress against recovery

criteria outlined in this plan and report to relevant sponsor organisations. Significant developments will be communicated to the general public through Listing Statement updates, relevant newsletters and reports.

This plan is consistent with the aims of the *Threatened Species Strategy for Tasmania* (2000) and *Tasmania's Nature Conservation Strategy* (2002).

Affected Interests and Social and Economic Impacts

Lomatia tasmanica has legal protection as listed threatened species at the State and Commonwealth level. The site in which this species occurs is on world heritage reserved land maintained for its natural values.

Through public and scientific interest in *Lomatia tasmanica* the profile of all threatened species is raised in the general community. This has social impacts by increasing public awareness about Tasmania's unique biodiversity and specifically other endemic threatened species.

Lomatia tasmanica is an iconic species due to its age and rarity. Like the Wollemi pine (*Wollemi nobilis*), the occurrence of *L. tasmanica* highlights the importance of conserving large undisturbed areas which have provided refugia and maintained ancient, slow-growing populations of rare species. The Aboriginal community is currently being consulted to determine whether there are any Aboriginal issues or interests identified in this Recovery Plan. If no role is identified for indigenous communities in the recovery of this species, opportunities may exist through cultural interpretation and awareness of this species.

The implementation of this Recovery Plan is unlikely to cause significant adverse social and economic impacts.

Biodiversity Benefits

This species is recognised as being ancient in origin and a relictual rainforest species. Such species are of broad scientific interest as they provide strong indications of past climate and geological processes. The existence of this living relic suggests that there has been minimal environmental change in southwest Tasmania over the past 40 000 years and highlights the importance of habitat conservation for maintaining biodiversity. Little is known about other species that may have associations with *L. tasmanica* such as invertebrates or fungi and for this reason further research and conservation of the species is integral in ensuring the maintenance of biodiversity.

Lomatia tasmanica is of particular significance as it is contrary to the commonly held theory that genetic diversity is important for the long-term survival of a species. Its lack of genetic diversity and possible inability to sexually reproduce is one of the causes for its current status as Critically Endangered.

Such rare ancient living relics are iconic species worldwide, with *L. tasmanica* being a species of particular focus to educators, scientists and the general public as it is considered the oldest living plant in the world.

RECOVERY ACTIONS

1. Declare a quarantine area

The declaration of a quarantine area would help to prevent the spread of *Phytophthora cinnamomi* by anthropocentric means. A quarantine area can be declared under the *Parks and Reserves Management Act 2002* and Regulations. Regulation 11 would be the most appropriate in this case as it limits access to authorised individuals. Fines are applicable for unauthorised entry into the restricted area.

Signs would need to be erected in strategic locations around the site, however fencing would not be required. The main cost associated with this action would be erection of the signs. This could be factored into the Parks and Wildlife Service works program to reduce travel expenses.

Associated with the quarantine area should be a field protocol for entry to the site that ensures authorised visitors to the site are not increasing the risk *Phytophthora cinnamomi* infection. For example: previous used footwear and field equipment should be sterilised prior to departure and washdown stations used on field trips. Appendix 3 contains an example of such a protocol currently used by NSW Parks & Wildlife when visiting the Wollemi Pine.

Co-operation between the Parks and Wildlife Service and the Threatened Species Section would be important to the success of this action.

Cost estimate	Timeframe
\$4,000	Year 1-2

2. Habitat quantification

Experimental laboratory isolation trials need to be conducted to assess links with ongoing survival of the species in cultivation.

The lack of vigour in *ex situ* plants highlights a need for further information *L. tasmanica*'s growth requirements. Soil and root material should be collected from the existing population site in small amounts to determine if there are any mycorrhizal associations and identify any associated soil microfauna. Soil should also be collected from Southport around the location of Mr and Mrs P Archer's surviving grafted specimen. In addition soil should also be collected and analysed from any sites determined to be suitable for *ex situ* plantings. Inoculation trials using plants in cultivation should also be conducted to attempt to improve growth and survival rates of cultivated individuals (see Action 3).

Currently the microclimatic requirements for the species are unknown. Installation of a small automatic weather station to record incident solar radiation, air and soil temperature, relative humidity and wind speed will provide useful information on the species microclimatic habitat which can then be used to further investigate the lack of vigour of *ex situ* collections. This information will also be useful for identifying and prioritising suitable site for future *ex situ* plantings.

Costs for this action involve laboratory and glasshouse use, materials and wages. Soil collection and automatic weather station installation should coincide with the planned monitoring expeditions to reduce travel costs (Action 5). It may be beneficial to offer this action as a paid study opportunity through the University of Tasmania.

Cost estimate	Timeframe
\$15,000	Year 1-3

3. Propagation

A study on the vegetative propagation of *Lomatia* species was conducted by J. Cambecedes in 1995. In this study, it was found that *Lomatia tasmanica* could be more successfully propagated from plants grown from cuttings rather than those taken from the wild population. Cambecedes (1995) successfully propagated specimens by subjecting the stock plants to long periods of dark to promote etiolation and fast growth of shoots. From these long shoots she had a 100% success rate taking cuttings. However Cambecedes expressed the need for repeat trials to verify the reliability of this treatment. Ken Gillander has also developed a nurse graft propagation technique that is described in Appendix 1. It is recommended that similar trials using existing *ex situ* plants (see Appendix 1) be conducted.

In addition to conventional propagation (*ex vitro*) as described above, it would be useful to further pursue micro-propagation (*in vitro*) through tissue culture. Preliminary trials have identified that the species can be tissue cultured, however, the hormone requirements for establishments are unknown, and more research is needed. The advantage of *in vitro* propagation is that it is low maintenance and replicate plants can be obtained from a few originals, which is suitable for *L. tasmanica*, as genetic diversity is not an important consideration.

If successful, a series of cuttings and/or new plants should be taken annually from plants in cultivation for the term of this Recovery Plan. This would allow ongoing propagation and increase the number of individuals and populations in existence, ensuring the survival of the species. The propagation of sufficient plants may allow the establishment of *ex situ* populations in the wild in future years beyond the term of this Plan. Note that any collection of propagation material from the wild will require a permit issued under provisions of the TSP Act.

The Royal Tasmanian Botanical Gardens and the Threatened Species Section agree to jointly develop and manage *Lomatia tasmanica* propagation research and the establishment of an *ex situ* collection through a Public Authority Management Agreement (PAMA). At present there are very few plants *ex situ*. This is attributable to the species low propagation success. The PAMA between the RTBG and TSS will ensure the continued research and efforts to establish a living collection, which will be curated at the RTBG for *ex situ* conservation purposes only.

Costs for this action include the wages associated with both the propagation trials.

Cost estimate	Timeframe
\$20,000	Year 1-4

4. Identify potential habitat

A desktop survey should be conducted to determine all potential habitat areas for *Lomatia tasmanica*. This study would serve two purposes:

- determine the likelihood of other existing populations
- locate areas suitable for the establishment of populations in the wild

It is recommended that a GIS (incorporating digital elevation models, orthorectified aerial photographs, BIOCLIM etc) be used to conduct this study. GIS software allows superior spatial interrogation of data. For example, in searching for suitable habitat it would be possible to query existing information on topography, hydrology, climate and vegetation in a single project. This type of interrogation rationalises the amount of time required to perform these types of inquiries whilst also increasing accuracy.

Given the likely remote location of potential habitat, opportunistic survey of potential habitat identified by this action should be undertaken in conjunction with other research and management work in the region that is undertaken by DPIW or the Parks and Wildlife Service.

Cost estimate	Timeframe
\$5,000	Year 1-3

5. Monitoring

Little is known about the life cycle of the species. It is therefore recommended that a series of monitoring trips be conducted and that a coordinated attempt between researchers and the Parks and Wildlife Service is made to find more out about this unique species. This is inherently difficult due to the remote location of the species.

A timetable of four weeklong field trips over the term of the recovery plan is suggested. It is envisaged that two field trips be conducted in year 2 and two in year 4. The initial visit would allow for a reassessment of the population and the spread of *Phytophthora cinnamomi*. This survey would be best conducted in February to coincide with flowering. The second survey should be conducted in spring to determine if any young re-sprouts can be observed. The following two surveys in year 2 should be conducted in autumn and spring. Autumn is recommended to encompass a different period in the life cycle and spring once again to determine if any re-sprouting is occurring.

In addition an attempt should be made to coordinate with other research or management trips into the area throughout the years of the plan. Ideally an agreement would be made to allow for yearly inspection of the species and *Phytophthora cinnamomi* risk. This agreement would need to involve the Threatened Species Section, the World Heritage Area botanists in the Vegetation Section of DPIW, and the Parks and Wildlife Service. This would allow a collaborative approach and reduce expenditure required for monitoring of this species.

Costs for 4 field trips including travel, co-ordination costs and costs associated with monitoring and wages. Co-ordination responsibility rests with DPIW and DTAE.

Cost estimate	Timeframe
\$10,000	Year 1-5

6. Determine appropriate disturbance requirements

The determination of disturbance requirements needs a field study to assess what type and amount of disturbance is required for ongoing recruitment in the population. This study should examine gap phase recruitment by tree fall and the effects of fire on the survival of the species. Any field trips should coincide with the planned monitoring expeditions to reduce cost and impact to the site.

Cost estimate	Timeframe
\$10,000	Year 1-4

7. Habitat management

Advise and help Park Managers to manage habitat in order to maintain or increase population size through protection from wildfire and *Phytophthora cinnamomi*, with the aim of maintaining or increasing population recruitment.

Cost estimate	Timeframe
\$5,000	Year 1-5

8. Emergency response mechanisms

A response mechanism to deal with infection by *Phytophthora cinnamomi* should be developed to prevent extinction of this species in the wild. An emergency response plan would be best developed by the *Phytophthora cinnamomi* Management Section within the Vegetation Section, Biodiversity Conservation Branch,

DPIW. Ongoing study and work has been conducted on *Phytophthora cinnamomi* in buttongrass sedgelands and a methodology for emergency eradication is being developed but would need to be adapted to suit *Lomatia tasmanica*. To establish a methodology based upon known research would require relatively little cost. Instigation of a response would be more costly and costs would need to be detailed in the emergency response plan.

Cost estimate	Timeframe
\$2,000	Year 1-3

9. Long-term management

This action involves collation and interpretation of data pertaining to *Lomatia tasmanica* and dissemination to stakeholders in the appropriate form. This is necessary to base management advice, allocation of resources and assessment of the impact of proposals for works on the best available information at any time. This action is also required to encourage and allow community participation in and ownership of the Recovery Plan implementation process.

Ongoing data and data interpretation requirements as new information becomes available are:

- entry of spatial information into TSS and DPIW GIS systems
- collation of additional information required to assess the conservation status such as population and threat data and inclusion in a TSS database
- regular reassessment of conservation status, storage of revised assessments in a TSS database and preparation of nominations for a change in the conservation status for State and Commonwealth legislation as required
- Entry into TSS database (ie: new populations, population decline and threshold conditions) and regular assessment of database to determine whether management intervention is required
- maintain monitoring data and information on *ex situ* populations

Requirements for the dissemination of information are:

- update Listing Statement every five years or as new information becomes available and circulate to libraries, the wider botanical community (including the Tasmanian Flora Network) and include on the TSS website to give access to the general public
- update the Recovery Plan every five years, submit for adoption by the Commonwealth, and circulate to libraries, the wider botanical community (including the Tasmanian Flora Network) and include on the TSS and DEH websites to give access to the general public
- update written management advice on populations to managers as necessary

Mechanisms to facilitate community participation and ownership are:

- establish a Recovery Team when funding is procured to implement this plan or parts thereof
- make requests to volunteer networks (e.g. Wildcare, Threatened Species Network) to participate in specific recovery actions at least six weeks in advance (general requests for participation usually generate little interest)
- request participation in recovery actions by the wider botanical community through the Tasmanian Flora Network
- when necessary, organise permission from managers to access populations and permits from the TSS for the collection of propagation material or herbarium specimens
- support the establishment of a publicly accessible *ex situ* plant to satisfy the community and tourists potential desires to view the a specimen of the world's oldest living vascular plant.

Costs for this action include those associated with maintenance of databases and websites, updates and circulation of literature, requests for participation in the Recovery Team and recovery actions including

provision of training and supervision when necessary and other co-ordination costs. Responsibility rests with DPIW.

Cost estimate	Timeframe
\$14,000	Year 1-5

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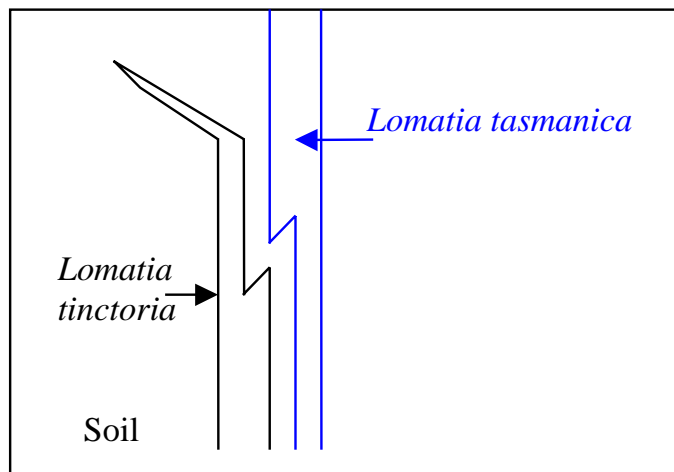
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APPENDIX 1. KNOWN PLANTS IN CULTIVATION

In 2005, the known specimens remaining in cultivation include:

- One plant held at the Australian National Botanic Gardens
- Two plants (one of moderate health) held by the School of Plant Science, University of Tasmania
- One mature plant (in moderate health), three smaller plants held at the Royal Tasmanian Botanical Gardens
- Two small plants (poor health) held at the Royal Botanical Gardens, Kew, London, U.K.
- A large surviving grafted specimen is held by Mr and Mrs P Archer (as pictured on front and rear covers)
- Five to six plants grafted onto *Lomatia tinctoria* and one plant of *Lomatia tasmanica* (approximately 1 metre in height) held by K. Gillander.

K. Gillander uses these plants for cutting material, and has achieved a strike rate of about 90 % using a nurse-grafting technique. This allowed for the *Lomatia tasmanica* graft to be fused with the *L. tinctoria*, whilst also allowing the *L. tasmanica* section to extend into the soil (see illustration below as described by Alan Gray, December 2003).



Gillander's grafting technique

APPENDIX 2. Preliminary Quarantine Procedures

Preparation of a specific *Lomatia tasmanica* emergency response plan would be best developed by the *Phytophthora cinnamomi* Management Section within the Vegetation Section, Biodiversity Conservation Branch, DPIW. In 2001 Tim Rudman (Flora Protection Officer, Nature Conservation Branch, DPIWE) provided the following preliminary advice for quarantine practice in and around *Lomatia tasmanica* to reduce the likelihood of *Phytophthora cinnamomi* infection and consequent extinction of *Lomatia tasmanica*. This provides a basic overview of what needs to be considered within an emergency response.

1. Identify a *P. cinnamomi* management area the population. Prescriptions applying to this area should be:
 - to minimise the further spread of *P. cinnamomi* in the catchment of *L. tasmanica*
 - no management operations should be conducted outside the known *P. cinnamomi* infected areas without the application of hygiene
 - helicopters used to access the area not marked as infected should be clean and only *P. cinnamomi* helipads/sites visited enroute
 - when access or landing on the plain beneath the stands washdown of footwear will be required prior to entering the gully or forest at the last point of disease
 - fire fighting must be conducted using water from disease free catchments or from within the stands where it is used locally. Freney lagoon and Miller Lagoons are not to be used as a water source to *P. cinnamomi* contamination
 - consideration needs to be given to managing public access based on assessment of who and how often the stand is visited, particularly post-fire as walking access is via *P. cinnamomi*
2. Further verification of *P. cinnamomi* susceptibility in mature plants in native soils needs to be assessed once propagation problems are overcome
3. If mature plants are susceptible, undertake phosphonate trials to develop emergency response for treatment should *P. cinnamomi* induced-mortality commence in the population
4. Should a fire occur within a stand of *L. tasmanica* all susceptible plant species (including *L. tasmanica*) should be monitored regularly (2 month intervals initially) for evidence of disease (*P. cinnamomi* induced) development until canopy closure. Where *L. tasmanica* shows evidence of disease developing treatment with phosphonate should be considered.

APPENDIX 3 An example of a “Site Hygiene Procedure” for a rare species.

Wollemi Pine Site Hygiene Procedures (NSW National Parks and Wildlife Service 1998)

Procedures for hygiene and prevention of entry of disease-causing organisms at the Wollemi Pine site.

Aim: The aim of these procedures is to prevent disease-causing organisms from entering or being transported into the area in which the Wollemi Pines are located. At present there appear to be no pathogens present at the site at which the Wollemi Pine is found. Soil tests performed by the Plant Disease Diagnostic Unit, Royal Botanic Gardens, Sydney showed that *Phytophthora* and other root pathogens did not appear to be present. It is essential to ensure that these types of organisms are not transported into the site as the effects are likely to be severe. It is likely that the Wollemi Pine, like other members of Araucariaceae, will be susceptible to attack by organisms such as *Phytophthora cinnamomi*. Prevention of these diseases is the best method of control.

The following procedures outline steps that should be taken when it is necessary to enter the site. Such stringent measures are the only means by which it is possible to minimise the entry of these pathogens.

Procedures. The most important pathogens of trees are carried in the soil. All the following procedures aim to prevent entry of soil or to disinfect those soil particles that may adhere to personnel.

1. All material taken into the site should be free of soil. Preferably it should be cleaned before trips to the site and should be sterilised with an appropriate sterilant such as bleach (sodium hypochlorite) or a commercial disinfectant (eg. biogram). Clothes and backpacks should be washed with a detergent prior to trips to the site. secateurs, trowels, spades and other such equipment should be sterilised carefully to ensure no possible transportation of pathogens. Shoes and boots should be carefully cleaned prior to trips to the site.
2. A footbath should be used to clean footwear prior to entering the immediate area around and adjacent to the trees. Again a sterilant such as bleach or biogram is appropriate. A sterilant which requires a higher dilution rate is recommended as the amount that is needed to be carried is much less. Shoes should be soaked in the sterilant for one minute. It is advisable to remove shoes as the sterilant can be damaging to the skin of some people.
3. New sterilant should be prepared on each new entry to the site. The life of these sterilants when exposed to soil particles is very short. The old sterilant must be removed from the immediate vicinity